

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Kevin M. McKinley on 04/05/10.

The application has been amended as follows:

Drawings

Figures 1-3 have been amended (per attached draft amended drawings).

Specification

Specification has been amended as follows:

1) Page 10, line 2 – “and an antenna unit 3 for irradiating the microwave into the chamber 1”, has been amended to “a waveguide 6; a coaxial waveguide 2 comprising inner conductor 2a and outer conductor 2b; and an antenna unit 3 for irradiating the microwave into the chamber 1”;

2) Page 10, line 10 – “The microwave generated from the high frequency power supply 5 is provided to the antenna unit 3 by a waveguide 6” is amended to “The inner conductor 2a of the coaxial waveguide 2 is connected to the slot plate 3c for supplying microwaves generated by the microwave source 5 to the slot plate 3c”;

3) Page 14, line 14 - "waveguide 6" has been amended to "coaxial waveguide 2".

In the claims

Claim 1 (Currently Amended): A plasma processing apparatus for performing a process on a substrate by exposing the substrate to a plasma, the apparatus comprising:

A microwave source;

A coaxial waveguide comprising an inner conductor and an outer conductor, wherein the inner conductor is connected to a slot antenna for supplying microwaves to the slot antenna;

a chamber for accommodating therein the substrate on a susceptor, the chamber including side walls;

a dielectric top plate member disposed on an upper portion of the chamber; ~~an~~ the antenna having a plurality of slots for irradiating a microwave towards an inside of the chamber through the top plate member, the antenna being disposed on the top plate member and being in close contact therewith;

a gas injection opening for supplying a processing gas into the chamber; and a vacuum pump for exhausting the inside of the chamber, wherein the top plate member includes:

a dielectric flat plate portion formed to face the substrate, the dielectric flat plate portion extending substantially horizontally to the chamber side walls; and

a dielectric sidewall portion formed to extend from a peripheral region of the fiat plate portion along the chamber side walls towards the substrate in a plasma

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generation region, wherein the sidewall portion extends substantially to the periphery of the susceptor,

wherein sides of the flat plate portion and the sidewall portion have a curved surface facing the plasma generation region and extending between the flat plate portion and the sidewall portion and a thickness of the sidewall portion between the chamber sidewalls and the plasma generation region is constant and is not smaller than $\lambda/4$ but not greater than λ_g , and a thickness of the flat plate portion between the antenna and the plasma generation region is not smaller than $\lambda/4$ but not greater than λ_g , λ_g being a wavelength of the microwave, and

wherein the microwave propagates from the flat plate portion to the sidewall portion and then is supplied towards a periphery portion of the substrate, thereby enhancing a uniformity of a plasma density in a radial direction of the substrate.

Claim 11 (Currently Amended): A plasma processing apparatus for performing a process on a substrate by exposing the substrate to a plasma, the apparatus comprising:

A microwave source;

A coaxial waveguide comprising an inner conductor and an outer conductor,
wherein the inner conductor is connected to a slot antenna and supplies microwaves to the slot antenna from the microwave source;

a chamber for accommodating therein the substrate on a suceptor, the chamber including side walls;

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a dielectric top plate member disposed on an upper portion of the chamber;

~~an~~ the antenna having a plurality of slots for irradiating a microwave towards an inside of the chamber through the top plate member, the antenna being disposed on the top plate member and being in close contact therewith;

a gas injection opening for supplying a processing gas into the chamber; and
a vacuum pump for exhausting the inside of the chamber, wherein the top plate member includes:

a dielectric flat plate portion formed to face the substrate, the dielectric flat plate portion extending substantially horizontally to the chamber side walls; and

a dielectric sidewall portion formed to extend from a peripheral region of the flat plate portion along the chamber side walls towards the substrate in a plasma generation region wherein the sidewall portion extends substantially to the periphery of the susceptor, and

wherein sides of the flat plate portion and the sidewall portion have a curved surface facing the plasma generation region and extending between the flat plate portion and the sidewall portion and a gap distance between the top plate member and the antenna is equal to or smaller than $\lambda_g/10$, λ_g being a wavelength of the microwave,

wherein the microwave propagates from the flat plate portion to the sidewall portion and then is supplied towards a periphery portion of the substrate, thereby enhancing a uniformity of a plasma density in a radial direction of the substrate~

wherein a thickness of the sidewall portion between the chamber sidewalls and the plasma generation region is constant and is not smaller than $\lambda_g/4$ but not greater

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than λ_g , and a thickness of the flat plate portion between the antenna and the plasma generation region is not smaller than $\lambda_g/4$ but not greater than λ_g , λ_g being a wavelength of the microwave.

Allowable Subject Matter

Claims 1, 5-7, 9-11, 15, 18, 19, 23 and 24 allowed.

Reasons for Allowance

The following is an examiner's statement of reasons for allowance:

Claims 1, 11 – Closest prior art Kazumi et al (JP 2000-331998) does not teach claim limitations “A coaxial waveguide comprising an inner conductor and an outer conductor, wherein the inner conductor is connected to a slot antenna for supplying microwaves to the slot antenna”; “wherein the sidewall portion extends substantially to the periphery of the susceptor” ; “sides of the fiat plate portion and the sidewall portion have a curved surface facing the plasma generation region and extending between the flat plate portion and the sidewall portion and a thickness of the sidewall portion between the chamber sidewalls and the plasma generation region is constant and is not smaller than $\lambda/4$ but not greater than λ_g , and a thickness of the flat plate portion between the antenna and the plasma generation region is not smaller than $\lambda/4$ but not greater than λ_g , λ_g being a wavelength of the microwave; and “wherein the microwave propagates from the flat plate portion to the sidewall portion and then is supplied towards a periphery portion of the substrate, thereby enhancing a uniformity of a plasma

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density in a radial direction of the substrate” in the context of remaining limitations of the claim.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RAKESH DHINGRA whose telephone number is (571)272-5959. The examiner can normally be reached on 8:30 - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Parviz Hassanzadeh can be reached on 571-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Parviz Hassanzadeh/
Supervisory Patent Examiner, Art Unit 1716

/R. D./
Examiner, Art Unit 1716